

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)	
)	
Revision of Part 15 of the Commission's)	
Rules Regarding Ultra-Wideband)	ET Docket No. 98-153
Transmission Systems)	
)	
)	

JOINT PETITION FOR PARTIAL RECONSIDERATION

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Summary

Satellite radio appears headed for success, providing millions and possibly tens of millions of American consumers a new and rich diversity of audio services in their cars and homes. The Commission's new rules for ultrawideband devices, however, will disrupt the quality of the listening experience for many and perhaps all of those users. Disregarding evidence that satellite radio receivers are necessarily highly sensitive and will operate in close proximity to UWB communications and surveillance devices, the new rules permit these unlicensed devices to emit an unprecedented amount of energy in the satellite radio band (2.3 GHz), an amount that Sirius and XM have shown will lead to disruption in consumer service. Sirius and XM urge the Commission to reconsider these rules and adopt a limit for UWB communications and surveillance devices that prevents the emissions from an aggregation of such devices to exceed 8.6 microvolts per meter at three meters.

The UWB rules are based on several faulty assumptions, including the following:

- the order exaggerates the link margin available to satellite radio receivers and assumes incorrectly that there will always be a terrestrial repeater nearby boosting the satellite radio signal (in fact, no more than one percent of the United States will be covered by repeaters and even there, the link margin often will be small)
- the order inaccurately assumes that satellite radio receivers and UWB communications and surveillance devices will operate no closer together than 8.8 meters and that there will never be more than one UWB device at a time operating in the vicinity
- the order fails to account for consumers listening to satellite radio in their homes
- the order assumes without support that UWB manufacturers will not build equipment to the limit permitted by the rules
- the order assumes that what it calls "transient" interference is irrelevant, when in fact it is highly disruptive to consumer enjoyment of a high-quality audio service
- the order ignores previous Commission national and international actions limiting interference in the SDARS band to acceptable values

The order also errs by putting the burden on satellite radio consumers to identify and resolve the interference that does occur. This approach is both impractical and inconsistent with the Commission's longstanding policy that the burden rests with unlicensed device manufacturers and users to prevent interference to users of licensed services.

Finally, the order compounds these errors by suggesting that the Commission intends to further relax the restrictions on UWB device emissions in the next few months. Any such action, particularly before there is real-world experience with real-world UWB devices, is only going to make an already troubling problem a cause for even greater concern.

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JOINT PETITION FOR PARTIAL RECONSIDERATION

Sirius Satellite Radio Inc. ("Sirius") and XM Radio Inc. ("XM") jointly petition for partial reconsideration of the Commission's First Report and Order ("R&O") in this proceeding, in which the Commission adopted rules allowing Ultra-Wideband ("UWB") devices to operate as unlicensed devices under Part 15 of the Commission's rules.¹ The adopted rules permit harmful interfering UWB emissions in the 2320-2345 MHz band allocated on a primary basis to the Satellite Digital Audio Radio Service ("SDARS" or "satellite radio"). A number of decisions in the R&O relating to emissions in the SDARS band from UWB communications and surveillance devices are contradicted by, or are not supported by, evidence in the record; other decisions are unsupported by any reasoned explanation. In fact, the Commission's brief analysis of potential interference from UWB to satellite radio focuses on vehicular radar, which is highly unlikely to interfere with satellite radio because it operates in frequencies over 20 GHz away from the SDARS band. These decisions are arbitrary and capricious and therefore adopted

¹ *Revision Of Part 15 Of The Commission's Rules Regarding Ultra-Wideband Transmission Systems*, FCC 02-48 (Released Apr. 22, 2002) (the "R&O").

contrary to the requirements of the Administrative Procedure Act (“APA”). These unlawful decisions will result in serious interference to satellite radio receivers, will severely damage the ability of potentially millions of customers to enjoy satellite radio service, and must be reconsidered on an expedited basis.

Background

The Commission is well aware of the SDARS licensees’ system designs and requirements.² Satellite radio receivers use very small aperture near omni-directional antennas connected to low noise radio frequency amplifiers operating in a mobile environment. Like most satellite receivers, SDARS receivers operate near the noise floor, with a link margin just sufficient to protect against outages from blockage, multi-path fading, and foliage attenuation. As a result, satellite radio receivers are very sensitive to interference from nearby emissions into the SDARS band.³ The SDARS licensees have submitted detailed analyses showing that, to protect satellite radio reception, aggregate emissions from unlicensed devices should be no higher than 8.6 μ V/m at 3 meters for free space, co-polarized conditions, as measured in a 1 MHz bandwidth.⁴

² American Mobile Radio Corporation, 13 FCC Rcd 8829 (Int’l Bur., 1997); Satellite CD Radio, 13 FCC Rcd 7971 (Int’l Bur., 1997); *Amendment Of The Commission’s Rules To Establish part 27, The Wireless Communications Service (“WCS”)* at ¶25, 12 FCC Rcd 3977 (Adopted March 31, 1997) (the “WCS Order”).

³ See Comments of XM Radio Inc., ET Docket 98-153, at 3 (Filed Sept. 12, 2000). Comments of Sirius Satellite Radio, ET Docket 98-153 at 2-5 (Filed Apr. 25, 2001); Comments of Sirius Satellite Radio, at 16, ET Docket 98-153 (Filed Sept. 12, 2000).

⁴ See Multispectral Solutions, Inc., Sirius Satellite Radio Inc., XM Radio Inc. joint *ex parte* letter, at 3, ET Docket 98-153 (Filed Feb. 7, 2002); see also Comments of XM Radio Inc., ET Docket 98-153, at 1 (Filed Sept. 12, 2000); Reply Comments of XM Radio Inc. at 2, ET Docket 98-153 (Filed May 10, 2001); Reply Comments of Sirius Satellite Radio Inc. at 1, ET Docket 01-278 (filed March 12, 2002). See also Air Transport Association

The Commission has decided that SDARS must be protected from excessive interference if the service is to be successful and the public is to benefit.⁵ In the past year, both SDARS licensees have begun providing services across the United States. Satellite radio receivers are becoming more widespread every month, and Sirius and XM are confident that the service will continue to grow and will soon provide the benefits of multi-channel, high-quality, nationwide digital radio broadcast to millions of Americans. In the next few years there will be millions of SDARS receivers operating very near perhaps millions of UWB devices.

Nevertheless, the Commission has adopted emission limits that will not protect satellite radio receivers from harmful interference, therefore threatening the success and public benefits of the service.⁶ In particular, the Commission has adopted inadequate emission limits for the two types of UWB devices most likely to be used in proximity and cause harmful interference to SDARS receivers: communications and surveillance devices.⁷ These devices will almost certainly

of America *et al*, joint *ex parte* letter, at 4 (Filed Nov. 15, 2001) (proposing a comparable out of band UWB emission limit of –160dBW/MHz peak at 3 meters, below 6 GHz).

⁵ See WCS Order at ¶ 27. See also *Agreement Between the Government of the United States of America and the Government of the United Mexican States Concerning the Use of the 2310-2360 MHz Band* (July 24, 2000) (“U.S.-Mexico DARS Agreement”); Letter from Michael Binder, Assistant Deputy Minister, Spectrum, Information Technologies and Telecommunications, Industry Canada to Ambassador Vonya B. McCann, U.S. Coordinator and Deputy Assistant Secretary, International Communications and Information Policy, U.S. Department of State (August 25, 1998); *United States and Canada Agree on Conditions for Implementation of U.S. Satellite Digital Audio Radio Services (DARS) and Canadian Terrestrial Digital Radio Broadcast Services (T-DRB) along the U.S./Canada Border Area*, Report No. IN 98-50, News Release (Sept. 3, 1998) (collectively, “Canadian and Mexican Coordination Agreements”).

⁶ The Commission’s adopted emission limits appear to cause serious harm to other services as well. Recent testing shows that UWB devices *operating at the Commission’s adopted limits* caused interference to aviation landing systems, “knock[ing] out the ILS [Instrument Landing System] localizer.” Jeffrey Silva, “UWB May Interfere With Landing Gear,” RCR Wireless, June 10, 2002.

⁷ See §§ 15.511(d), 15.517(c), 15.519(c). Due to the operating bands adopted for these devices, technically the emission limits into the SDARS band for surveillance devices is

become ubiquitous and operate in close proximity to satellite radio receivers. To compound the serious harm caused by these inadequate emission limits, the Commission has adopted definitions and operating limitations that will exacerbate the interference threat.

Discussion

The APA requires that, in every informal notice and comment rulemaking proceeding, such as the UWB proceeding, the Commission must, in its decision, (i) provide a reasoned basis for its actions, (ii) consider all of the evidence presented to it, and (iii) articulate a rational connection between the facts presented to the Commission and the choice it has made.⁸ The Commission's decisions also must be supported by the record⁹ and must respond to well-supported arguments that are contrary to the Commission's ultimate decision.¹⁰

an "in-band" limit, whereas the limits for communications devices are "out-of-band" limits. *See Id.*

⁸ *See Motor Vehicle Manufacturers Association of the United States v. State Farm*, 463 U.S. 29, 46-57 (1983); *Sithe/Independence Power Partners, L.P. v. FERC*, 165 F.3d 944, 949-50, 952 (D.C. Cir. 1999) (agency must provide clear explanation of rationale and reveal the data and assumptions underlying its findings); *Schurz Communications v. FCC*, 982 F.2d 1043, 1050 (7th Cir. 1992) (vacating an FCC rule because key concepts were left unexplained and key evidence was overlooked); *Flagstaff Broadcasting Foundation v. FCC*, 979 F.2d 1566 (D.C. Cir. 1992) (the court will set aside an action by the Commission when it fails to provide a reasoned basis for its decision); *Bechtel v. FCC*, 957 F.2d 873, 881 (D.C. Cir. 1992) (Commission must address serious challenges); *see also Action for Children's Television v. FCC*, 821 F.2d 741, 746 (D.C. Cir. 1987). In particular, The D.C. Circuit has held that in the context of considering approval of new services, the Commission violates the APA if it "omit[s] an explanation" or "fail[s] to justify adequately its choice of an interference threshold," since "[c]onclusory explanations for matters involving a central factual dispute where there is considerable evidence in conflict do not suffice to meet the differential standards of our review." *AT&T Wireless Services, Inc. v. FCC*, 270 F.3d 959, 968 (D.C. Cir. 2001).

⁹ *See Action for Children's Television v. FCC*, 852 F.2d 1332, 1341, 1343 (D.C. Cir. 1988).

¹⁰ *Illinois Public Telecommunications Association v. FCC*, 117 F.3d 555, 564 (D.C. Cir. 1997).

Several decisions in the R&O fail to meet these requirements. The rules for communications and surveillance devices—in particular, the emissions limits—which were adopted on the basis of unsupported assumptions, without reasoned explanation, or in contradiction to the Commission’s rules, must be reconsidered. Sirius and XM respectfully propose that, in place of the improperly adopted limits, an emission limit of 8.6 $\mu\text{V/m}$ at 3 meters measured in a 1 MHz bandwidth¹¹ be applied to emissions into the SDARS frequency band from surveillance devices,¹² indoor communications devices, and hand-held devices.

I. Two Types Of UWB Devices—Communications Devices And Surveillance Devices—Pose A Significant Interference Threat To SDARS Due To Their Allowed Emissions Into The SDARS Band And The Deployment Scenarios For These Devices.

Two types of devices—communications devices and surveillance devices—pose a particular threat of interference to satellite radio because both are likely to operate close to satellite radio receivers and to be very densely deployed. The emission limits adopted for even a single device alone will not protect SDARS receivers from harmful interference, let alone multiple entries. Furthermore, although the Commission claims to limit proliferation of those devices most likely to cause interference, the adopted rules exacerbate the problem.

¹¹ To the extent that specific device applications can be identified as unlikely to operate in free space line of sight, such as automotive in-cabin devices, or of different polarization or modulation, higher out-of-band interference levels can be selectively authorized; for automotive in-cabin devices, 12.5 $\mu\text{V/m}$ at 3m, measured in a 1 MHz bandwidth, would be appropriate.

¹² With respect to the SDARS band, this limit is proposed for surveillance systems only, and not for other devices under the category of “mid-frequency imaging devices.”

A. Communications devices

“Communications Systems and Measurement Systems”¹³ includes “UWB devices such as high speed home and business networking devices...[which] must be designed to ensure that operation can only occur indoors or it must consist of hand held devices....”¹⁴

Indoor UWB devices may emit energy in the SDARS band at -51.3 dBm.¹⁵ This is equivalent to 157.2 $\mu\text{V/m}$ at 3 meters, *two and a half times higher* than the nominal received *signal* of a satellite radio receiver. The Commission has not explained why it did not adopt (or even consider) the 8.6 $\mu\text{V/m}$ limit submitted by XM and Sirius. Furthermore, although the Commission has *three times* considered and then adopted emission limits to protect satellite radio, it provided no explanation for why it did not adopt (or consider) the 5.8 $\mu\text{V/m}$ limit adopted for the WCS licensees in Part 27, or the limits adopted under the Coordination Agreements with Mexico and Canada.¹⁶

Hand-held devices may operate anywhere.¹⁷ The R&O notes that significant concerns were raised regarding potential interference, largely because of the potential for

¹³ Sirius and XM do not believe UWB measurement systems are likely to cause interference to SDARS receivers.

¹⁴ R&O at ¶15. The adopted rules do not define “Communications Device,” although the other device categories are defined. *See* §15.503, as adopted.

¹⁵ *See* §15.517(c), as adopted.

¹⁶ *See* 47 C.F.R. §27.53(a)(2). For WCS licensees operating in the 2305-2320 MHz and 2345-2360 MHz bands, the power of any emission in the SDARS band from mobile and most portable transmitters must be attenuated below the transmitter power (P) by a factor of $110 + 10\log(P)$ dB. Assuming a 1 Watt WCS mobile transmitter, this equates to a signal level of -80 dBm (5.8 $\mu\text{V/m}$). The limit for new Canadian fixed systems is -155 dBW/m²/4kHz, which is equivalent to 5.5 $\mu\text{V/m}$, *see* Canadian Coordination Agreement at 4; the limit adopted for terrestrial systems at the U.S.-Mexican border is -154 dBW/m²/4KkHz, which is equivalent to 6.2 $\mu\text{V/m}$, *see* Mexican Coordination Agreement at Appendix 1.

¹⁷ *See* §15.519, as adopted.

“uncontrolled proliferation of these devices.”¹⁸ In response, the Commission adopted what it calls an “extremely conservative” emission mask for hand-held devices, including a -61.3 dBm limit for emissions into the SDARS band. This is equivalent to 49.7 $\mu\text{V/m}$ at 3 meters, almost *five times less restrictive* than the limit needed to protect satellite radio receivers from harmful interference.¹⁹

The Commission apparently believes it has reduced the interference risk from hand held devices by preventing deployment of a “fixed infrastructure.”²⁰ However, the Commission’s rules exacerbate the interference problem by allowing increased deployment of both known and unknown devices, and therefore greater interference.

First, the requirements that these devices be “*relatively small*,” and that UWB antennas may not be mounted on outdoor structures,²¹ will not control proliferation.²² Antennas will simply be mounted on the UWB device itself, which can be placed anywhere outdoors without being permanently mounted. *Second*, requiring devices to be “*primarily hand-held while being operated*” does not prevent deployment of outdoors infrastructure since devices may operate even when *not* being hand-held. *Finally*, limiting transmission to an “associated

¹⁸ R&O at ¶67.

¹⁹ Again, the Commission has acted arbitrarily and capriciously by providing no reasoned explanation for why it did not adopt or consider either the limit submitted by XM and Sirius, the limit adopted in Part 27, or the limits contained in the Canadian and/or Mexican Coordination Agreements.

²⁰ §15.503(m), as adopted; *see also* R&O at ¶20.

²¹ §15.519(a), as adopted.

²² For example, UWB devices of indeterminate size (“relative” to what?) could be placed on tables, on the ground, or around the perimeter of parking lots, malls, fairgrounds, or other public spaces to create a communications network without “fixed infrastructure.”

receiver”²³ does not limit aggregate interference, since each UWB device will be an “associated receiver” with respect to other UWB devices, and these transmissions will cause significant aggregate interference.

The definition as written will not limit “uncontrolled proliferation.” The adopted rules permit a dense, temporary, semi-permanent, or mobile UWB communications network. Aggregate emissions into the SDARS band from this dense network will cause serious interference, signal degradation, and outages. The Commission’s vague and insufficient definitions must be reconsidered.

B. Surveillance devices

“Surveillance Systems” are UWB devices that “operate as ‘security fences’ by establishing a stationary RF perimeter field and detecting the intrusion of persons or objects in that field.”²⁴ Operation is permitted between 1990 MHz and 10,600 MHz.²⁵ As adopted, the maximum EIRP for these devices in the SDARS band is -41.3 dBm.²⁶ This is equivalent to 500µV/m at three meters—more than *eight times* higher than the nominal signal level received from an SDARS satellite.²⁷

Whereas other imaging systems are limited to use by law enforcement, fire, and rescue organizations, surveillance systems may be used by a huge number of entities:

²³ §15.519 (a)(1), as adopted.

²⁴ R&O at ¶ 5.

²⁵ See R&O at ¶ 54.

²⁶ See R&O at ¶ 54; §15.511 as adopted.

²⁷ The Commission has again acted arbitrarily and capriciously by not adopting or considering the limits submitted by XM and Sirius, those adopted in Part 27, or those contained in the Canadian and/or Mexican Coordination Agreements.

“manufacturers licensees, petroleum licensees or power licensees defined in 47 C.F.R. §90.7.”²⁸

The Section 90.7 definitions for these entities mean that surveillance systems can be used at, among other places, plants, factories, shipyards, mills, refineries, and electrical generation and distribution facilities, as well as subsidiary or supporting facilities (warehouses, shipping facilities, corporate offices, etc.).²⁹

Surveillance systems can therefore be used by a vaguely defined but clearly immense group of entities. The adopted rules will ensure that a huge number of surveillance devices will come into contact with satellite radio receivers, particularly those installed in cars. UWB surveillance perimeters along the roadside fence of factories, power stations, and warehouses will all bring these devices into close proximity with satellite radio receivers in cars traveling alongside, parked near, or leaving and entering the installation.

The Commission notes that it adopted “stringent” emissions limits for hand-held devices due to “concerns of interference... centered about the potential for uncontrolled proliferation of these devices.”³⁰ However, the Commission failed to consider the need for stringent limits on surveillance devices—despite that fact that its expansive list of permitted users will ensure “uncontrolled proliferation.” In fact, by failing to address the likely proximity of surveillance systems to satellite radio receivers and resorting instead to arbitrary and unsupported rationalizations, the Commission has adopted emissions limits into the SDARS band that will ensure harmful interference to the potentially millions of satellite radio users. In addition, the Commission states that “surveillance systems will operate only at fixed locations

²⁸ R&O at ¶ 21, n. 43.

²⁹ See 47 C.F.R. §90.7

³⁰ R&O at ¶ 67.

such that harmful interference can be avoided through coordination.”³¹ Coordination, however, will not benefit satellite radio consumers, most of whom will use their satellite radios in cars and will be traveling through interference zones created by surveillance systems with no realistic opportunity of prior coordination with the huge and diverse numbers of operators of these systems.

II. The Commission Adopted UWB Emissions Limits Into The SDARS Band On The Basis Of Determinations That Are Arbitrary And Capricious Because They Are Contradicted By Or Not Supported By The Record Or Are Contrary To The Commission’s Rules.

The Commission addresses potential interference into SDARS in a single paragraph.³² This discussion contains a number of fundamental errors and arbitrary or unsupportable assumptions and conclusions, all of which must be reconsidered.

A. The Commission has underestimated the minimum separation distance needed to protect satellite radio receivers

Based on its analysis of UWB interference into satellite radio receivers, the Commission concludes that, for the emission levels adopted, the minimum separation required to protect a satellite radio receiver is 8.8 meters.³³ As discussed in the attached Technical Appendix, the Commission underestimated the required separation distance because, among other incorrect assumptions, it assumed a polarization mismatch factor of 3 dB³⁴ and an SDARS receiver noise temperature of 360°K. With only these factors corrected, the actual separation

³¹ R&O at ¶ 55.

³² See R&O at ¶ 169.

³³ See R&O at ¶169.

³⁴ In addressing interference to GPS from UWB, the Commission stated that “we do not believe that a factor for polarization mismatch loss should be included in the analysis” because UWB “polarizations are unknown at this time.” R&O at ¶ 92. Thus, there is no basis for applying a polarization mismatch factor to interference between UWB and SDARS.

distance required between a UWB device and an SDARS antenna at the emission levels adopted is 55 meters for a surveillance device, 17 meters for an indoor UWB device, and 5 meters for an outdoor handheld device.

B. The Commission arbitrarily assumes that interference can be mitigated by separating UWB and SDARS devices by 8.8 meters.

XM and Sirius have both advocated a line-of-sight, co-polarized emission limit for all UWB devices of 8.6 $\mu\text{V/m}$ at 3 meters (-76.3 dBm over 1 MHz) into the SDARS band.³⁵ At this limit, UWB devices can come within 3 meters of an SDARS antenna and in direct line-of-sight without causing interference. Any emission limit for UWB devices that allows them to cause interference to satellite radios at distances greater than 3 meters is unreasonable because UWB devices are extremely likely to be located in close proximity to satellite radios. The Commission, however, assumes that 8.8 meters is a reasonable separation distance.³⁶ This distance is inadequate because indoor communications devices, hand-held communications devices, and surveillance devices will all come within this distance, some with high deployment density. For example, few vehicles are larger than 8.8 meters, so any hand-held UWB communications device used inside a vehicle (*e.g.*, a car,) will cause interference. SDARS-equipped cars passing UWB surveillance perimeters will also be well within this distance.

Satellite radio receivers in a home or business will also likely be located much closer to indoor UWB communications devices than 8.8 meters. The Commission states that an satellite radio receiver, if not operating in a vehicle, will be “mounted . . . on the roof or side of a

³⁵ See Multispectral Solutions, Inc., Sirius Satellite Radio Inc., XM Radio Inc. joint *ex parte* letter, at 3, ET Docket 98-153 (Filed Feb. 7, 2002)

³⁶ R&O at ¶ 169.

building.”³⁷ This is not the case. Many satellite radio receivers can operate indoors without an outdoor antenna. In fact, the concern has specifically been raised that UWB devices in residential environments would be “in close proximity to DARS receivers operating . . . within the home.”³⁸ Thus, there is no basis in the record to support the Commission’s conclusion that a satellite radio receiver will generally be located only on the roof or side of a building. The Commission has arbitrarily ignored this certain interference threat, and as a result the adopted emission and operating limits must be reconsidered.

C. The Commission arbitrarily and erroneously assumes that interference can be avoided by moving a receiver away from a UWB device.

As part of its analysis of UWB interference to licensed services, the Commission concludes that “any interference at close distances can be easily remedied by moving the devices a short distance apart.”³⁹ This assumption is a necessary part of the Commission’s analysis of interference into satellite radio receivers because that analysis is grounded on avoiding interference by relying on adequate separation between the satellite radio receivers and the UWB device. However, this assumption has two fatal problems. *First*, it shifts the burden to the operator of a licensed system to avoid interference, in contradiction to the Commission’s Part 15 rules. *Second*, it won’t work in practice.

The Commission impermissibly has placed at least part of the burden to eliminate interference on the user of a licensed device. This is directly contrary to Part 15 of the

³⁷ R&O at ¶ 169.

³⁸ See Comments of XM Radio, ET Docket No. 98-153, at 10 (Sept. 12, 2000).

³⁹ R&O at ¶159.

Commission's rules, which requires the operator of unlicensed Part 15 devices to cease operation if the devices cause harmful interference.⁴⁰

This impermissible “quick fix” also will not work. First, there will be no recognizable “signature” to UWB interference into a satellite radio receiver, so the user will not even realize there is interference to begin with. In the case of UWB interference, unlike the obvious static or interrupting signal of a CB radio, for example, there will likely be no audible, interrupting signal—the SDARS audio will simply drop out. Since it will not be obvious that there is an interfering signal, the user will interpret the interruption as a result of a fault in the SDARS service or equipment. In other words, they will blame the satellite radio service provider or manufacturer.

Most importantly, the interfering UWB device will very frequently be controlled by someone other than the satellite radio listener. For example, a satellite radio receiver in a vehicle may suffer interference from a UWB device in an adjacent vehicle, a UWB device used by a passing pedestrian, or from a nearby surveillance system. In these cases, the satellite radio consumer will not know the location of the interference source from which he must move the receiver, even if he could move.

Even if the user somehow understands that UWB interference is the cause of signal dropouts (as opposed to problems with the satellite radio system), the user may not realize *how* to mitigate it. Increasing separation distance may not be obvious to the satellite radio listener. Instead, the listener may change channels, restart the satellite radio receiver, etc., none of which will eliminate the interference.

⁴⁰ See 47 C.F.R. §15.5(c).

Finally, even if the user somehow understands that there *is* interference, knows where it is, and knows that it can be solved by moving away from the UWB device, the user may not be *able* to mitigate the interference. It may simply be impossible to move the devices far enough to eliminate the problem. The Commission concludes (as we have shown earlier, erroneously) that the separation distance necessary to protect a satellite radio receiver is 8.8 meters.⁴¹ Customers listening to satellite radio in the home or office may not have sufficient space to locate their receivers 8.8 meters from their UWB communication system. An SDARS user passing a UWB surveillance system may not be able to drive far enough from the surveillance system. Finally, few of the vehicles in which satellite radio receivers will be installed will be large enough to allow for the required separation. This problem is magnified many times since, as previously described, the correct separation distance from UWB surveillance systems is over six times larger than 8.8 meters.

The Commission has either ignored these likely scenarios, contravened Part 15 rules, or has determined that it can wish the problem away by stating that authorized users will be able to move away from the interfering UWB device when that simply is not the case. Either approach results in an arbitrary, unsupported decision that is contrary to the requirements of the APA and can not support the Commission's decisions.

⁴¹ See R&O ¶169; see also discussion *supra*, pp 10-11.

D. The Commission has assumed arbitrarily and contrary to the record that the SDARS signal will be above the normal operating level and UWB emissions will be below the maximum allowed level.

1. The Commission erroneously assumes that SDARS systems will typically operate above the minimum received signal level.

SDARS satellite signal levels are fixed, cannot be increased, and will be invariant until the next generation of satellites is launched. Like most satellite receivers, SDARS receivers must operate close to the noise floor.⁴² While the receivers are designed with a margin, this margin is needed to handle multi-path fading, foliage attenuation, and other effects. The emissions of UWB devices densely deployed within a few meters of the satellite radio receiver will completely overwhelm the operating margin and result in frequent signal loss and consequent severe degradation of service.

2. The Commission arbitrarily assumes that UWB devices will operate below the maximum permitted levels.

There is no reason or evidence that all or even most UWB designers will independently design their devices to operate “somewhat below” the maximum permitted levels.⁴³ To the contrary, it would seem logical for UWB communications and surveillance devices to be designed at the maximum operating level, to increase range and effectiveness. And even if some UWB devices operate “somewhat below” the maximum level, dense deployment will wipe out any presumed advantage due to the effect of aggregation.

E. Vehicular radar is not likely to cause interference to SDARS and therefore cannot be used as basis for assessing interference to SDARS.

The Commission’s brief analysis of UWB interference to SDARS is dominated by a discussion of the lack of interference threat from vehicular radar devices. However, the

⁴² See *supra*, p. 2.

⁴³ R&O at ¶169.

Commission has entirely missed the point that *vehicular radar is highly unlikely to interfere with SDARS*.⁴⁴ The Commission's conclusion from this discussion—that, therefore, there is no interference threat to SDARS from all other UWB user devices—is unsupported and arbitrary.

Sirius and XM assume that paragraph 169 of the R&O contains the entirety of the Commission's rationale for the adopted emission limits for all UWB device categories into the SDARS band, since nowhere else in the R&O does the Commission address UWB interference to satellite radio receivers. If the discussion in paragraph 169 is not the basis for the SDARS band limits, then the Commission has not provided *any* reasoned analysis for their adoption, which is equally insufficient under the APA.

1. The Commission erroneously and arbitrarily assumes that vehicular radar will be the closest to SDARS, and apparently assumes that therefore no other UWB devices can cause interference into SDARS receivers.

The record does not support a conclusion that vehicular radar devices will be the closest UWB devices to satellite radio receivers.⁴⁵ Satellite radio receivers in cars will be located close to these devices, but other UWB devices will be closer (for example, a hand-held UWB communications device used by a passenger in a car.)

⁴⁴ Vehicular radar's operating band is so far from the SDARS band that there is little possibility of harmful interference from these devices into satellite radio receivers, despite their physical proximity. However, the Commission has arbitrarily adopted a limit for vehicular radar emissions into the SDARS band (-61.3 dBm, equivalent to 49.7 $\mu\text{V}/\text{M}$ at 3 meters) which is nearly *six times higher* than the 8.6 $\mu\text{V}/\text{m}$ necessary to protect SDARS. Since vehicular radars are unlikely to emit energy into the SDARS band up to this limit, and the 8.6 $\mu\text{V}/\text{M}$ limit in the SDARS band is necessary to protect SDARS in the unlikely event this does occur, Sirius and XM urges the Commission to adopt the 8.6 $\mu\text{V}/\text{m}$ limit for out-of-band emissions from these devices in the SDARS band.

⁴⁵ See R&O ¶ 169.

Regardless, the proximity of vehicular radar to satellite radio receivers is meaningless. Because of the widely separated operating frequencies, vehicular radar is highly unlikely to cause interference to satellite radio. However, the Commission has apparently concluded that, because vehicular radars will be closest to satellite radio receivers, and since vehicular radar does not pose an interference threat to satellite radio, no other UWB device will interfere with satellite radio.⁴⁶

However, the proximity of benign devices provides no rational basis to discount the threat of problematic devices, or to justify the adopted limits. A hand-held communications device in an SDARS-equipped car, a surveillance device near an SDARS-equipped car, or an indoor communications device a few feet from an indoor satellite radio receiver will still cause harmful interference even if another, benign UWB device is closer.⁴⁷ This Commission conclusion is arbitrary, illogical, and unsupported by the record.⁴⁸

⁴⁶ The Commission here may be relying on its earlier assumption that “only the closest transmitter placing an emission on the frequency of concern would be of importance.” R&O at ¶ 226. It is highly unlikely, however, that a vehicular radar will place an emission in the “frequency of concern,” *i.e.* the SDARS band. Therefore, even if the Commission is correct that it must consider only the closest UWB device emitting in the SDARS band, vehicular radar is unlikely to be that device. Thus, the Commission cannot rely on proximity of vehicular radar to ignore the interference threat of UWB communications and surveillance devices.

⁴⁷ In addition, as the Commission notes, emissions from multiple UWB transmitters “are additive.” R&O at ¶ 226.

⁴⁸ It is possible that the Commission simply did not think to address operating scenarios and interference from other device types. However, this is insufficient under the APA. The record is replete with evidence of interference threats from other devices, and the Commission cannot simply ignore these serious issues. *See, e.g., Schurtz Communications*, 982 F. 2d 1043, 1050 (7th Cir. 1992); *Bechtel*, 957 F. 2d 873, 881 (D.C. Cir. 1992).

2. The Commission can not rely on the fact that vehicular radar will not be pointed at SDARS to support its decisions, because vehicular radar does not pose an interference threat to SDARS.

The Commission is correct that “vehicular radar systems would likely be pointed in a direction other than at an SDARS antenna.”⁴⁹ These devices are directional and will generally point away from a satellite radio receiver located in the same car.⁵⁰ However, SDARS licensees do not expect vehicular radar to pose an interference threat to satellite radio reception because of each system’s vastly different operating frequencies. Thus, the directionality of vehicular radar is irrelevant to the real interference threat to satellite radio from other UWB devices and cannot support the Commission’s decisions.

3. The assumption that vehicle manufacturers will “engineer” SDARS and vehicular radar systems to avoid interference is irrelevant and ignores the real interference threat to SDARS.

While it may be true that “the vehicle manufacturer will engineer (vehicular radar and SDARS) systems to ensure that there is no mutual interference,” this does not address the actual threat of interference from other UWB devices.⁵¹ Manufacturers of hand-held UWB devices will have no control over the location and use of their devices, which are designed to be mobile. Manufacturers of indoor communications devices will have no control over their use or placement. Consumers will simply install these devices, unaware of any need and unable to “engineer” them to avoid problems. Factory owners and other entities authorized to use

⁴⁹ R&O at ¶169.

⁵⁰ Of course, vehicular radars in *other* cars will be pointed *directly at* the satellite radio receiver. However, the operating band assigned to vehicular radar means that they are highly unlikely to cause interference.

⁵¹ Sirius and XM assume that by “engineer,” the Commission means that a vehicle manufacturer will shield devices, orient and place them properly, and take other steps to minimize the already very low interference potential posed by vehicular radar. Sirius and XM assume the Commission does not mean that vehicle manufacturers will somehow be responsible for re-engineering UWB devices or satellite radio receivers themselves.

surveillance devices will hardly “engineer” their systems to ensure they will not emit energy near a satellite radio receiver.

Once again, the Commission has arbitrarily and without support relied on the fact that vehicular radars will not cause interference to satellite radio receivers to support its emission levels and operating limits for devices that *will* interfere with SDARS. These decisions must be reconsidered.

F. The Commission assumes arbitrarily and contrary to all evidence that interference will be mitigated by presence of terrestrial repeaters.⁵²

The Commission’s discussion in paragraph 169 of the R&O ends with the conclusion that “DARS will be supplemented in major metropolitan areas with high powered terrestrial broadcasting stations, further reducing the potential for harmful interference.”⁵³ However, this “solution” impermissibly shifts the burden to the operator of a licensed system to mitigate the interference that will be caused by an unlicensed Part 15 device. This assumption, which helps the Commission justify the inadequate emission limits in the SDARS band, is inconsistent with Part 15 and therefore arbitrary and capricious.

Even if repeaters *could* help mitigate UWB interference, the resulting “solution” would be available only to a tiny fraction of the SDARS coverage area. As the Commission is well aware, XM and Sirius rely on their satellites to provide service in 99% of the US land mass.⁵⁴ Satellite radio listeners in rural areas, in suburban areas, and in cities where repeaters are

⁵² R&O at ¶ 169.

⁵³ R&O at ¶ 169.

⁵⁴ See Comments of XM Radio Inc, ET Docket 98-153, at 4 (filed Sept. 12, 2000). “In the Notice, we noted that some satellite DARS applicants intend to implement, as necessary, terrestrial repeaters, or “gap-fillers”, in urban canyons and other areas where it may be difficult to receive DARS signals transmitted by a satellite.” *Establishment of Rules and*

not deployed would be left to suffer interference, degradation, and signal loss. The Commission provides no reasoned explanation for why repeaters, which it states will be available in “major metropolitan areas,” can apparently be considered as reducing harmful interference to satellite radio in general. Although the Commission may understand that the claimed mitigation will only be available to approximately 1% of SDARS coverage areas, this abandonment of the bulk (99%) of SDARS coverage areas to UWB interference is arbitrary and unsupportable.

Moreover, being near a terrestrial repeater will not solve the interference problem for many of the satellite radio receivers at issue. Terrestrial repeaters boost the SDARS signal by only several decibels in areas covered but removed from the repeater since the EIRP falls off 16 times for each doubling of distance from the repeater (Rayleigh fading). Since an SDARS receiver is at times operating close to threshold when only several kilometers from a repeater, the modest boost provided by the repeater will not help counter the high UWB interference levels.

G. The Commission’s assumption that imaging systems will operate intermittently is unsupported, is contrary to the Commission’s rules, and fails to address the problem of interference from surveillance devices.

The Commission states that “Imaging Systems typically will emit RF energy only for short periods of time, so any possible interference from operation at closer separations should be transient”⁵⁵ This conclusion can not support the Commission’s adopted rules for several reasons.

First, even “intermittent interference” from a Part 15 device to a satellite radio receiver is not acceptable. Part 15 conditions the operation of unlicensed devices on their not

Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, 12 FCC Rcd 5754, 126-27 (1997).

⁵⁵ R&O at ¶ 113.

causing “*harmful*” interference.⁵⁶ While intermittent interference may not be considered harmful for certain licensed services, it is extremely harmful for satellite radio service. For example, people using mobile phones have accepted the fact that intermittent outages or bursts of noise may occur during the course of a conversation. Intermittent outages or bursts of noise, however, will not be tolerated by a satellite radio subscriber who is paying for uninterrupted, high-quality digital audio. The Commission’s reliance on intermittent interference to support operation of these devices under Part 15 is arbitrary since it is in contradiction to Part 15 rules.

Furthermore, the record makes clear that surveillance systems—which are included under the category of imaging systems—will *not* “emit RF energy only for short periods of time.”⁵⁷ In fact, the Commission states that “surveillance systems operate...*by establishing a stationary RF perimeter.*” In other words, surveillance systems will emit RF energy *continually*.⁵⁸ Thus, satellite radio receivers passing the perimeter will receive continuous interference. The Commission’s reliance on intermittent operation is contradicted by the record and must be reconsidered.

Even if some surveillance devices *do* operate intermittently, they are still likely to cause continuous interference into satellite radio receivers. For example, a surveillance device might emit an intermittent signal to “sweep” an area. However, to protect a perimeter, a surveillance systems will have to include a large number of UWB devices. A satellite radio receiver in a car near a UWB-secured perimeter will pass a long series of these devices, so

⁵⁶ See 47 C.F.R. §15.5(b) (emphasis added.)

⁵⁷ *Id.*

⁵⁸ Other types of imaging devices (for example, wall-imaging devices) may indeed operate intermittently, but that is irrelevant to the operation of surveillance devices and their interference threat to satellite radio receivers.

interference will effectively be continuous. Because of the size of the entities permitted to use UWB surveillance devices (shipyards, factories, etc.), such continuous interference may last a significant time.⁵⁹ The assumption of intermittent operation is arbitrary, can not support the Commission's decisions, and must be reconsidered.

III. The Commission Acted Arbitrarily And Capriciously By Failing To Analyze Aggregate Interference And By Failing To Include That Analysis As An Additional Margin Of Protection, *i.e.*, Lower Individual Device Emission Limits.

Despite evidence in the record regarding the dangers posed by aggregate UWB emissions,⁶⁰ the Commission has arbitrarily ignored the aggregate interference threat it has exacerbated with its inadequate operating limits, and has failed to perform any analysis whatsoever to account for aggregate emissions in the emission limits. In fact, with respect to interference into satellite radio receivers, the Commission has not addressed aggregate interference at all.⁶¹

The "considerable restraints"⁶² the Commission claims to have adopted to protect against cumulative interference do not reduce the cumulative impact of UWB interference on satellite radio reception, since the Commission's rules allow widespread proliferation of hand-held devices, indoor communications devices, and surveillance devices, all of which are very likely to be in close proximity to satellite radio receivers.

The emission limits into the SDARS band for these devices are apparently based only on analysis of emissions from a single device. To address the aggregate interference

⁵⁹ Because of the number of entities that may deploy these devices, the SDARS user will encounter many such long periods of interference.

⁶⁰ *See, e.g.*, Assessment of Compatibility between Ultrawideband Devices and Selected Federal Systems, NTIA Special Publication 01-43 (January 2001), at x.

⁶¹ *See* R&O at ¶ 168-9.

⁶² R&O at ¶ 234.

evidence and to arrive at a logically supportable emission limit for single devices, the Commission would have had to perform an aggregate interference analysis. First, deployment architecture or density must be estimated, taking into account that surveillance devices will likely be installed in factories, power stations, and similar facilities, and that communications devices would be densely distributed throughout indoor environments and in vehicles. Second, the total emissions from the predicted UWB device density would be compared to the emissions for a single device. The difference would be factored into the single-device limit as an additional reduction to allow for the predicted density and resulting higher total emission received by the satellite radio (or other) receiver.

Although this procedure is clearly necessary based on the deployment allowed by the Commission, the Commission failed to perform this analysis or to explain why such an analysis was not done. This omission is arbitrary and capricious, and requires reconsideration of the adopted emission limits.

IV. The Commission's Determination To Possibly Relax UWB Emission Limits Within The Next Six-Twelve Months Is Arbitrary and Capricious and Unsupported by any Fact in the Record.

The Commission intends to "review the standards for UWB devices and issue a further rulemaking to explore more flexible technical standards . . . within the next six to twelve months."⁶³ The Commission also states that that the standards adopted in the R&O are "extremely conservative."⁶⁴ The Commission also notes that "these standards may change in the

⁶³ R&O at ¶1. Since the R&O was adopted on February 14, 2002, the Commission's statement that it intends to review the rules within "six to twelve months" indicates that it intends to review the rules sometime between mid- August and February, 2003, *i.e.* within three to nine months from now.

⁶⁴ R&O at ¶2.

future as we continue to collect data regarding UWB operations”⁶⁵ and “[o]nce additional experience has been gained with UWB operation.”⁶⁶

As discussed above, there is no basis for the conclusion that the current standards for communications devices and surveillance devices are “extremely conservative” and may be replaced by “more flexible” standards with respect to interference into SDARS. To the contrary, the Commission has already adopted inadequate standards for these devices that will lead to harmful interference to satellite radio receivers.⁶⁷ This certainly does not support loosening the restrictions. Indeed, the Commission provides no reasoned explanation—besides its general desire to promote UWB technology in general—to support its desire to relax the UWB rules it has just adopted.

In addition, there is simply no basis for the Commission’s proposed six to twelve month timetable. The Commission’s rationale for revisiting the rules is that new “data regarding UWB operations” and “further experience” will support the Commission’s assumption that the rules are too strict. However, it is highly unlikely that sufficient and meaningful new data could be obtained in this short timeframe. Certainly, no meaningful “experience” with UWB operations will be available in the categories of concern of this petition. UWB devices are simply not at a point where significant market penetration will be achieved to allow such “experience.” This is especially true for the devices that pose an interference risk to SDARS. The Commission’s decision to revisit and loosen the rules in six to twelve months is arbitrary and capricious and must be reconsidered.

⁶⁵ R&O at ¶12.

⁶⁶ R&O at ¶21.

⁶⁷ The Commission’s current limits are apparently also inadequate to protect aviation systems, *see supra* note 6.

V. Conclusion

In the UWB First Report and Order, the Commission adopted rules which will cause harmful interference to satellite radio receivers from UWB communications and surveillance devices. In adopting these rules the Commission has failed to meet the standards of the Administrative Procedure Act because it relied on assumptions contradicted by or unsupported by the record, failed to provide reasoned explanation for its decisions, and adopted rules contrary to existing Part 15 rules by shifting the burden of interference mitigation to users of licensed services and by not adhering to its definition of harmful interference. The R&O must be reconsidered in these respects. In lieu of the improperly adopted emission limits into the SDARS band for communications and surveillance devices, XM and Sirius propose that the Commission adopt for interference into the SDARS frequency band the previously submitted emission limit of 8.6 μ V/m at 3 meters. This limit will avoid interference to satellite radio listeners and is supported by record evidence, in conformity with the requirements of the APA.

Respectfully submitted,

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Technical Appendix

I. The Commission Incorrectly Addresses Relevant Separation Distances

In paragraph 169 of the R&O, the Commission calculates that a separation distance of 8.8 meters will be required between an SDARS receiver and a UWB device when the UWB device is emitting energy into the SDARS band at -51.25 dBm.⁶⁸ This assumes that the UWB device is an indoor device, although this level will cause harmful interference as described in the main text, the interference situation is further exacerbated by the errors in separation distance assumptions.

Assuming that the Commission's assumptions and analysis in paragraph 169 are valid, which they are not, as indicated in the chart below, for surveillance systems the separation distance required is 30 meters, not 8.8 meters.

Table 1

Type of UWB Device	Report and Order Emission Limit (dBm/1MHz)	Assuming 3 dB Polarization Mismatch	Actual Emission Level in SDARS Band(dBm/1MHz)	Approximate Required Separation Distance *
Surveillance	-41.3	-3	-44.3	30 meters
Indoor Comm.	-51.3	-3	-54.3	8.8 meters
Outdoor Comm.	-61.3	-3	-64.3	3 meters

* Assumes thermal noise reference of 360 deg K.(-110 dbm/2MHz (R&O ¶ 169))

II. The Commission Underestimates the Separation Distance Required Between a UWB Device and an SDARS Antenna

The Commission's separation distance analysis in paragraph 169 relies on two faulty assumptions regarding polarization and receiver noise temperature. When these assumptions are corrected, the required separation distances are much greater than those indicated in Section I above.

Polarization: The Commission assumes 3 dB of loss between SDARS circularly polarized antenna and the linear polarization "expected" for UWB devices. R&O at ¶ 169. This assumption is incorrect for two reasons. First, SDARS antennas use two types of polarization: circular for satellite reception and vertical linear for terrestrial reception. Second, there is no basis to assume that UWB devices will be linearly polarized, nor rules requiring UWB linear polarization. In fact, in addressing interference to GPS from UWB, the Commission stated that "we do not believe that a factor for polarization mismatch loss should be included in the

⁶⁸ In its analysis, the Commission assumes that the UWB signal is emitting at -41.25 dBm/MHz, but arbitrarily and without explanation assumes that 10 dB of attenuation is applied to the signal.

analysis” because UWB “polarizations are unknown at this time.” R&O at ¶ 92. Thus, it is improper to include a factor of 3 db for polarization mismatch in addressing interference to SDARS.

When this 3 dB polarization mismatch factor is correctly eliminated, the following separation distances are required between an SDARS antenna and a UWB device:

Table 2

Type of UWB Device	Report and Order Emission Limit (dBm/1MHz)	Assuming No Polarization Mismatch	Actual Emission Level in SDARS Band (dBm/1MHz)	Approximate Required Separation Distance
Surveillance	-41.3	-	-41.3	40 meters
Indoor Comm.	-51.3	-	-51.3	12 meters
Outdoor Comm.	-61.3	-	-61.3	4 meters

Receiver Noise Temperature. In its analysis, the Commission assumes that the noise temperature of an SDARS receiver is 360° K. (Noise Floor = -110dBm/2MHz). This is incorrect. The proper receiver noise temperature for an SDARS receiver is 158° K.⁶⁹ A receiver noise temperature of 290°K may be appropriate when the SDARS receiver is located in an urban environment. (Noise Floor = -111dBm/2MHz). When an SDARS receiver is located in an environment suitable for satellite reception, however, the proper receiver noise temperature is 158°K. (Noise Floor = -113.6dBm/2MHz). By assuming a 360°K receiver noise temperature, the Commission has understated the sensitivity of the SDARS receiver by a factor of 3.6 dB.

When the receiver noise temperature is corrected, the following separation distances are required between an SDARS antenna and a UWB device:

Table 3

Type of UWB Device	Report and Order Emission Limit (dBm1)	Assuming 3dB Polari-zation Mismatch	Assuming Correct 158K Receiver Noise Temperature	Actual Emission Level in SDARS band (dBm/1MHz)	Approximate Required Separation Distance
Surveillance	-41.3	-3	+3.6	-40.7	40 meters
Indoor Comm.	-51.3	-3	+3.6	-50.7	14 meters
Outdoor Comm.	-61.3	-3	+3.6	-60.7	4.5 meters

⁶⁹ See Application of Sirius Satellite Radio Inc. to Modify Authorization, File No. SAT-MOD-19981211-00099 (Dec. 11, 1998), at p. A-24.

Combined Effect of Correcting Polarization Mismatch and Receiver Noise Temperature:
When both polarization mismatch and receiver noise temperature are corrected, the following separation distances result.

Table 4

Type of UWB Device	Emission Limit (dBm/1MHz)	Assuming No Polari-zation Mismatch	Assuming Correct 158K Receiver Noise Temperature	Actual Emission Level in SDARS band (dBm/1MHz)	Approximate Required Separation Distance
Surveillance	-41.3	-	+3.6	-37.7	55 meters
Indoor	-51.3	-	+3.6	-47.7	17 meters
Outdoor	-61.3	-	+3.6	-58.7	5 meters

XM and Sirius both advocate an emission limit for all UWB devices of $8.6 \mu\text{V/m}$ at 3 meters (-76.3 dBm over 1 MHz) into the SDARS band.⁷⁰ At this limit, UWB devices of any polarization will be able to come within 3 meters direct line-of-sight of any SDARS antenna without causing interference. As Table 4 demonstrates, even at the incorrect emission limits adopted, the three categories of UWB devices analyzed above will cause interference to SDARS receivers at distances in excess of 3 meters: Outdoor Communications devices at 5 meters, Indoor Communications Devices at 17 meters, and Surveillance systems at 55 meters separations.

⁷⁰ See Multispectral Solutions, Inc., Sirius Satellite Radio Inc., XM Radio Inc. joint *ex parte* letter, at 3, ET Docket 98-153 (Filed Feb. 7, 2002)

Technical and Engineering Certification

I hereby certify that I am the technically qualified person ultimately responsible for the preparation of the technical and engineering information contained in this filing, that I have either prepared or reviewed that engineering information, and that it is complete and accurate to the best of my knowledge and belief.

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